IPC-8/250W

I.P. & RESISTIVITY Tx.

1.0 Introduction

The basic equipment required for Induced Polarization and Resistivity surveying comprises a transmitter, a receiver, wire and electrodes. The transmitter consists of a power source and an electronic control unit. The power source may be either a motor-generator set or batteries. A block diagram showing the basic IP/Resistivity system is presented in Figure 1.

The Scintrex IPC-8/250W is a battery powered transmitter for time domain I.P. and Automatic Commutated D.C. Resistivity surveying, designed primarily for use with Scintrex remote triggered I.P. and D.C. resistivity receivers. It consists of four modules: an electronic control unit, two 24V rechargeable battery packs, and a battery charger, which can be combined to form one easily portable package. During field operation, the control unit can be combined with either one or two battery packs depending on power requirements. Provision has been made for the use of another suitable 24V D.C. source, such as a motor-generator or set of automobile batteries, if this is desired for stationary operation.

For information on electrode arrays, field procedures, interpretation and other matters pertaining to induced polarization surveying, the reader is referred to other Scintrex literature as well as technical journals such as "Geophysics" and "Geophysical Prospecting". There are also an increasing number of text books available specifically written on the induced polarization technique.

2.0 Features

The modular construction combines an electronic control unit, two rechargeable lead-acid gel battery packs and a charger, in one easily portable package.

A carrying harness is attached for convenient field operation.

Depending on power requirements, the control unit may be combined with either one or two battery packs.

High field reliability is obtained by the simplicity of the circuitry, weatherproofed electronics and a rugged package including taut band suspended meters.

Current outputs of up to 1.5 amperes.

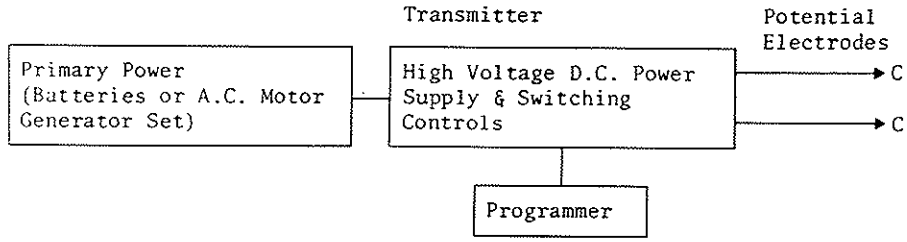

Figure 1
Basic Time Domain I.P. System

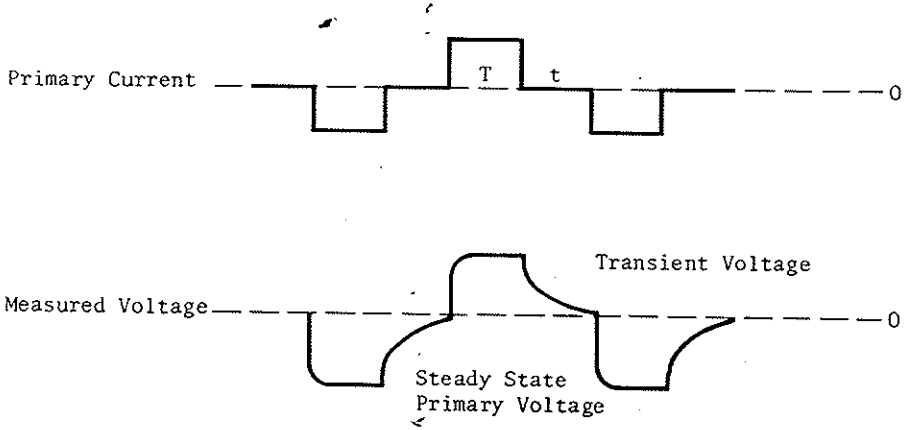

Figure 2
Waveforms of D.C. Resistivity Measurements.
The primary voltage, only, is received.

An Open Loop Protection Circuit safety feature automatically switches the transmitter off should the electrode circuit open.

Selectable pulse times of 1, 2 or 4 seconds are provided.

Maximum utilization of the stored battery power is achieved by the efficiency of a DC-DC converter.

3.0 Specifications

Power
- 250W

Output Voltage
- Switch selectable at: 150,212,300,425,600 or 850V.

Output Current
- 1.5A maximum

Meter Ranges
- 0 to 0.5 and 0 to 1.5A full scale, ±3%.

Automatic Cycle Timing
- T:T:T:T; on:off:on:off

Automatic Polarity Charge
- Each 2T

Pulse Durations
- T=1,2 or 4 seconds, switch selectable

Open Loop Protection Circuit
- Turns off high voltage automatically if output current is less than 50 mA. Open loop protection can be overriden manually by operator for testing purposes.

Power Sources
- 8 GC 660-1 lead-acid gel-type batteries 24V at 12 Ah or external 24V DC
- 1 Penlite Battery Eveready E91 or equivalent

Power Requirements for Charger
- 115/230V, 50 to 400 Hz, 100W

Dimensions and Weights
- Transmitter with two battery packs: 140 mm x 300 mm x 150 mm; 15.5 kg.

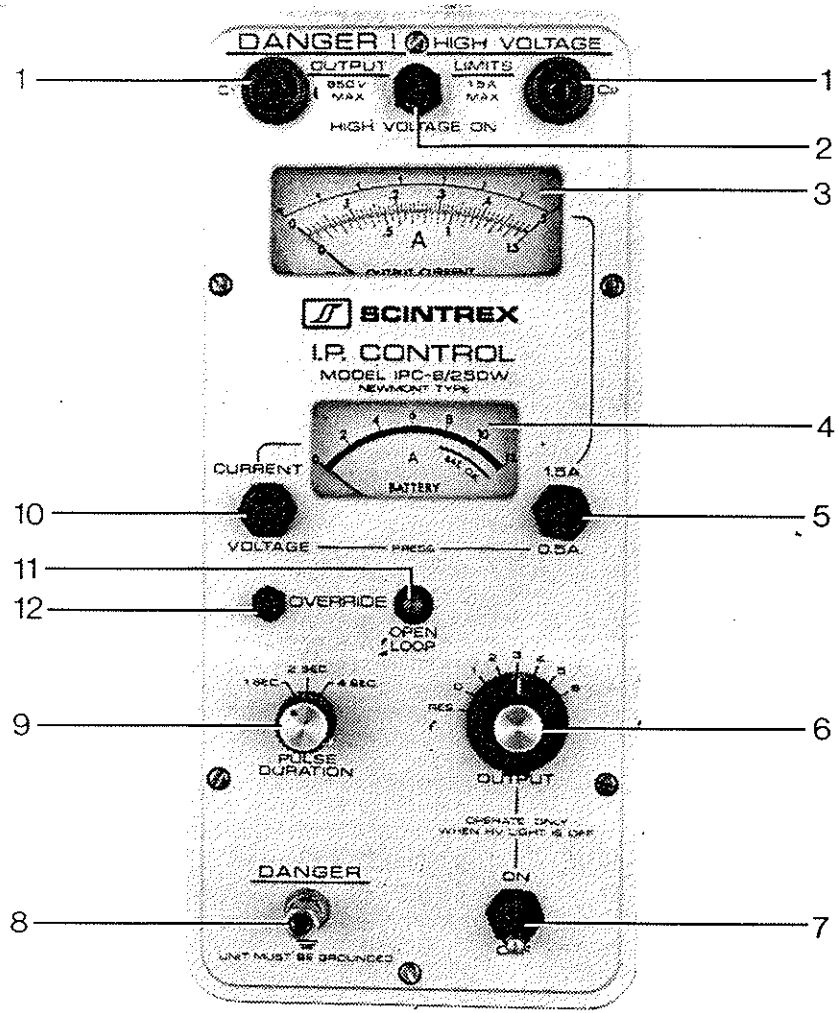

Figure 3
Front Panel of IPC-8/250W

Charger
- 140 mm x 300 mm 150 mm; 5.5 kg.

Operating Temperature
- 30 C° to + 55°C

Standard Accessories
- 2 Battery Packs, 1 Battery Charger, 1 Carrying Harness, 2 Supercon Plugs, Minor Spare Parts Kit.

Optional Accessories
- 2 Reels, Wire, 6 Porous Pots, 4 Tee Stakes, 4 Stainless Steel Stakes, 10 Alligator Clips, 1 kg Copper Sulphate, Major Spare Parts Kit, 4W Transceivers, Aluminum Tubular Backpack to carry the transmitter.

4.0 Front Panel Description

The numbers in the following discussion refer to the numbers shown in Figure 3.

1) Output Terminals: The high voltage output by the transmitter is delivered across these terminals. The wires connecting the transmitter to the current electrodes are connected to the terminals marked C_1 (current electrode nearest the potential dipole) and C_2 (current electrode farthest from the potential dipole).

2) Warning Light: This light glows when the output voltage is on.

3) Output Current and Ground Resistance Test Meter: Normally used to measure the amplitude of the current transmitted, however, when the Output Switch (6) is in the RES position, the current dipole resistance is shown on the upper scale.

4) Battery Current and Voltage Meter: Normally this meter measures the current delivered by the batteries, however, when the Battery Monitoring Meter Switch (10) is depressed, it measures the battery voltage.

5) Output Current Range Switch: This is used to select the coarse or fine current scales on the Output Current and Ground Resistance Test Meter (3). Normally the 1.5A full scale is used, however, when the Output Current Range Switch (5) is depressed, readings are made on the 0.5A full scale for additional accuracy, particularly at low currents.

6) Output Switch: This switch selects the level of the nominal output voltage. The positions 1 to 6 correspond to output voltages of 150, 212, 300, 425, 600 and 850V. The 0 position is the OFF position while the RES position is used to check the resistance of the current dipole circuit.

7) On-Off Switch: This is the master switch which controls current flow from the batteries to the console.

8) Grounding Terminal: When in use the transmitter must be grounded by running a wire from a grounded electrode to the Grounding Terminal. This protects the operator from shock should a stray voltage leak to the transmitter chassis.

9) Pulse Duration Selector Switch: This switch allows selection of the pulse duration (T in Figure 2, ie. ¼ period) of 1, 2 or 4 seconds.

10) Battery Current and Voltage Meter Switch: Normally the meter measures the current drain from the batteries on 12A full scale. When the Battery Current and Voltage Meter Switch is depressed, however, the meter measures the battery voltage. If the battery voltage is adequate, the needle will remain within the green line when the switch is depressed.

11) Open Loop Warning Light: If the current electrode wires are improperly connected to the Output Terminals (1) or to the electrodes, or if they have been broken, or if the contact resistance is so high that less than 50 mA of current are output, the open loop protection circuit automatically turns off the output voltage as a safety measure. The Open Loop Warning Light (11) then glows to indicate the condition.

12) Over-ride Switch: This switch is depressed once the conditions which caused the open loop protection circuit to trigger are corrected. It also needs to be depressed when using a simulator network to check the transmitter-receiver combinations since simulator circuits contain such high resistances that current flow is so low that the loop protection circuit triggers.

Warning
Before using this button ensure that all personnel are not touching the wires. As long as the switch is depressed the safety feature is inoperative.

5.0 Operating Instructions

Warning
Even though the transmitter is powered by batteries having rather low voltages, these voltages are transformed upwards resulting in hazardous voltages at the output terminals. Great care must be taken when operating the instrument, and proper communication has to be maintained with the helpers who handle the current electrodes and wires.

1) Each battery pack is a 24V DC source. They can be used singly or in parallel. Attach either one or two battery packs to the bottom of the transmitter. A connection is made to the battery pack by placing the transmitter on top of the battery pack so that the top battery connector fits into the back panel connector of the transmitter. The plastic rings, when fastened to the metal buttons hold the two units together. Detach the battery charger module before proceeding to the survey area. Surveys requiring little power can be done advantageously with only one battery pack. With the restriction as outlined in the following paragraphs, this method saves the operator from carrying another battery pack (weight 6 kg). If only one battery is used at a time, both packs should be used alternately to ensure even aging. In case it is desired to return to using both battery packs, they have to be recharged individually before connecting them together. For general applications it is preferable to use two battery packs together because two packs produce the same amount of power for a longer time than the total amount of power available from two packs used individually. The time that a battery can hold a charge versus power drain is not a linear relationship. See Section 6, Power Source and Section 8, Maintenance for more information on the batteries.

2) Connect the Grounding Terminal (8) to the metal grounding stake. This protection for the operator is important in case of an electrical insulation breakdown inside the unit.

3) Set the Pulse Duration Selector Switch (9) to the desired pulse length.

4) Ascertain that the Output Switch (6) is in the 0 (off) position, and that the ON-OFF Switch (7) is off.

5) Connect the electrode wires to the Output Terminals (1). This is done by attaching the wires to the Supercon Plugs provided and inserting these plugs in the terminals.

6) Check the ground resistance by turning the Output Switch (6) to the 'RES' position. Read the resistance on the uppermost scale marked kΩ on the Meter (3).

This check verifies that the current electrodes are connected, and indicates how well they are grounded. The transmitter should never be turned on unless good grounding is indicated. For zero adjustment see the troubleshooting section.

7) Turn the ON-OFF Switch (7) to OFF whenever adjusting the Output Switch (6) or the Pulse Duration Selector Switch (9). This will avoid the remote possibility of electrical component damage due to spikes being created by switching with the power ON.

8) Increase the output voltage one step with the Output Switch (6) and turn the On-Off Switch ON. If the required output current is not reached, as read on the Output Current Meter (3) then the On-Off Switch should be turned OFF, the Output Switch advanced and the transmitter turned ON. While advancing the Output Switch (6) the battery current should be monitored and kept in the green area. Special attention should be paid that both meter readings increase with clockwise switch rotation. If they fail to do so, the transmitter is overloaded and a lower switch position should be used. Operation under overload will not harm the unit immediately, but it results in very poor efficiency. Each time the output switch is advanced one position, the output current should approximately double. Current drain should be kept below 5.5A for a single battery pack, and below 11A for 2 battery packs as designated by the two red zones on the battery monitoring meter.

9) The Open Loop Protection Circuit is actuated when the output circuit is open or has too high a resistance, ie. when the output current drops below about 50 mA. This condition is indicated when the Open Loop Warning Light (11) is on.

Under the following conditions the Over-ride Switch (12) may be used to enable the IPC-8 to continue operating:

a) There is too high a resistance in the current dipole circuit causing the Open Loop Protection Circuit to come into operation.

b) When the "simulator network" is connected to the Output Terminals. The simulator network is 4.5 megohms.

c) When working in areas of high electrode contact resistance but where apparent resistivities are high enough and the electrode array is small enough that measureable signals can be seen at the receiver even if the output current is less than 50 mA. Safety precautions should be carefully adhered to in this type of operation since high voltages are used and the Open Loop Protection Circuit is overriden.

Operation of the Over-ride Switch

i) Turn the On-Off Switch OFF.

ii) Improve (lower) the resistance in the current electrode circuit and check it on the Ground Resistance Test Meter.

iii) Push down the Override Switch (12). This actuates the switch in the "ON" position until the switch is released. Do not release the switch.

iv) Turn the "ON-OFF" Switch to ON.

v) The transmitter will now operate and the Override Switch (12) can be released. If case b) or c) still applies the switch must be held down throughout the measurement.

vi) After the Override Switch (12) is pressed there is a delay time of 15 seconds before the transmitter turns off. This time period is required for the circuitry to fully discharge.

Caution

Whenever the override switch is used, the safety feature is bypassed and extreme care is necessary to ensure that no one will be hurt.

6.0 Power Source

1) Each battery pack is a 24V DC source. They may be used singly or, for extended life, connected in parallel.

2) To save the batteries, the power output should be kept at levels which give reasonable but not excessive signals at the receiver. The instrument should only be switched on when required for measurement.

3) Occasionally the battery voltage should be checked by depressing the Battery Current and Voltage Meter Switch (10) with the Output Switch (6) in the 0 position. If the needle remains below the green area the batteries should be recharged immediately to extend

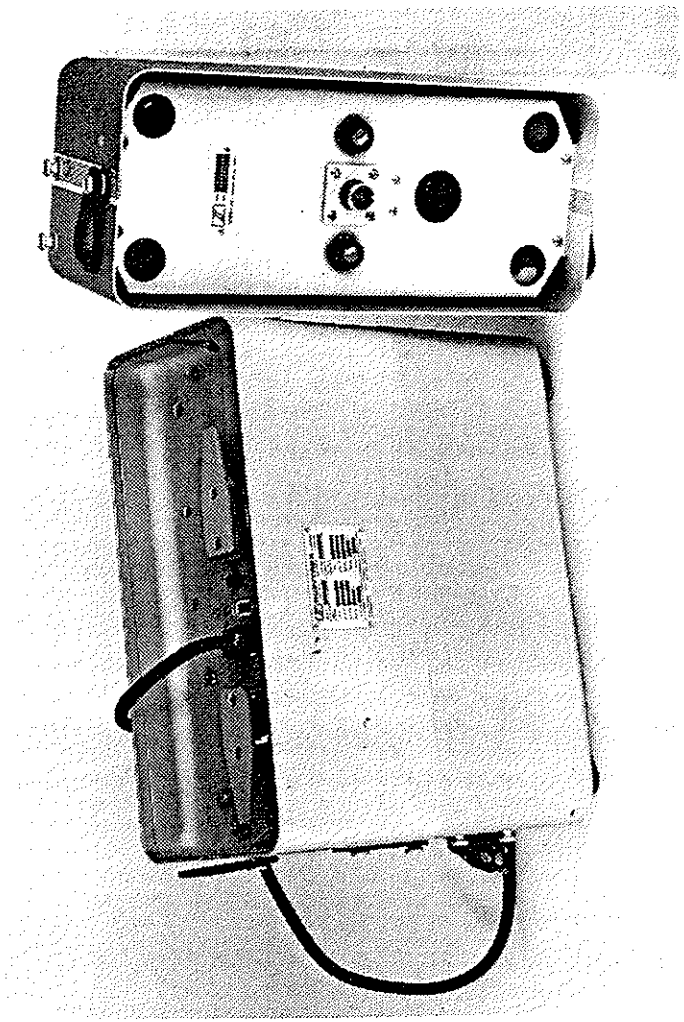

Figure 4
Battery Charger connected to two Battery Packs

the life of the battery.

4) For extended stationary operation, it might be advantageous to use some other power source, such as two car batteries or a motor-generator. To connect a 24V power supply to the IPC-8/250W make the following connection at the multipin connector (type MS 3106A-14S-6S) located on the back panel: Pin A negative, Pin B positive. The polarity has to be observed strictly to prevent damage to the transmitter. A 10A fuse within the transmitter protects the circuitry from any improper external connection.

5) To recharge the batteries, remove the transmitter from the battery packs and install the battery charger on the battery packs instead. Before connecting the charger to the AC power source, make sure the Line Voltage Selector is set for the proper voltage, either 115 or 230V AC. While charging, the red light will be on. When the batteries are fully charged the light will be off, or may be on and off intermittently. The charger should then be removed and not merely unplugged.

Recharging should take place at room temperature, and will take about 10 hours for a full charge.

As mentioned earlier, when only one battery pack is used, both should be recharged separately before combining them again.

A maximum of two battery packs may be charged simultaneously. Simultaneous charging should only be undertaken when the packs are being used together, in which case they will draw equal currents from the charger otherwise currents may flow from the stronger to the weaker battery causing a fuse to blow in the charger.

6) More information about the batteries is given in Section 8, Maintenance.

7.0 Principle of Operation

Figure 5 is a block diagram showing the major circuits of the IPC-8/250 Transmitter.

The 24V DC is chopped up in the convertor and transformed up. Depending upon which output winding or combination thereof is selected with the Output Switch (6), the voltage can be selected between 150 and 850V. The voltage levels differ by a factor of 1.4 from each other. The selected voltage is then rectified and applied to the Output Terminals (1) via the polarity reversing

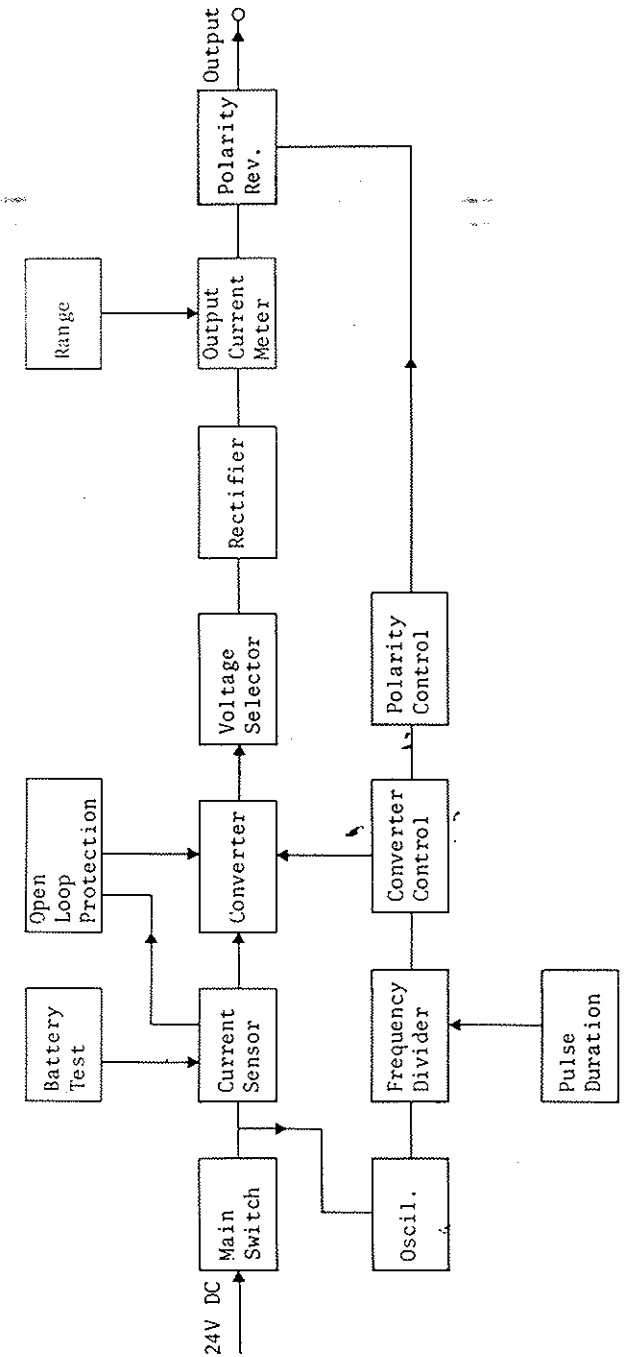

Figure 5
Block Diagram of Circuits

circuit. The output current is measured before the reversing circuit, resulting in perpetually positive readings. If the current drops below 50 mA the Open Loop Protection Circuit stops the conversion, thereby, removing the high voltage from the output. Basic timing of 1 sec. is generated by a relaxation type oscillator which triggers the converter control circuit directly for one second pulse times. To obtain 2 and 4 second pulse times, the oscillator output is divided, using flip-flops. Depending on the position of the Pulse Duration Selector Switch (9), the appropriate trigger signal is applied to the converter control circuit. The latter circuit is formed by a flip-flop made of silicon controlled rectifiers (SCR) and serves to start and stop the converter. After each power on pulse, the polarity control circuit is triggered to reverse its state. This circuit is identical to the converter control circuit and consists of a SCR flip-flop.

8.0 Maintenance

Warning
Do not attempt to connect the battery packs and operate the transmitter while the case is open as many exposed parts are under high voltage.

8.1 Ground Resistance Test Circuit Adjustment

As the battery supplying the Resistance Test Circuit ages, some adjustment will be necessary from time to time to bring the Output Current and Ground Resistance Test Meter (3) to 0Ω when the input terminals are shorted and the Output Switch (6) is in the RES position. To carry out this adjustment, separate the transmitter box from the battery packs. To open the transmitter case, six front panel screws and two screws at the multipin connector on the rear panel are removed and the case slipped off the front panel and chassis. Open the cover slowly to avoid pulling internal wires. With shorted output terminals the upper meter reading is adjusted to 0Ω with the small control located inside the IPC-8, next to the 1.5V Penlite Battery.

Periodically ensure that the 1.5V Penlite Battery is still good by measuring its voltage with a voltmeter.

When reassembling the front panel, screws should be tighened moderately.

8.2 Replacement of Warning Light Lamp

To replace the lamp in the Warning Light, unscrew the red lens cap and pull the lamp out of the lens cap. Use lamp No. 327 28V for replacement.

8.3 Battery Case

For optimum battery life use only the Battery Charger provided by Scintrex. Recharge the lead acid batteries as soon as possible after each day's use and at 6 month intervals if the instrument is kept in storage. Optimum storage temperature is 20°C or less. More frequent charging is required for higher storage temperatures to prevent battery deterioration. Storage temperatures exceeding 38°C should be avoided. Some 100-200 charge-discharge cycles of the batteries can be expected. With use or prolonged storage the batteries will lose their capacity to fully recharge. When operating time after a full charge is no longer satisfactory, it is time to replace the batteries. Charging only individual batteries is unsatisfactory due to inbalances created. One dead or poor battery will never allow the battery pack to reach full charge.

8.4 Fuses

Two 10A/32V fuses are mounted in each battery pack. The fuses may blow if there is a short within the battery pack, the IPC-8/250W or the battery charger. Within the IPC-8/250W is a 10A/32V internally mounted fuse located at the bottom side of the instrument. Improper polarity connections or too high current or voltage from an external battery supply may cause this fuse to blow. Never use a slow-blow fuse as this may damage other circuitry.

8.5 Check Current Electrode Circuit

Nine problems out of ten observed in the field operation of transmitters such as the IPC-8/250W occur within the current electrode circuit and can be easily rectified. Often broken field wires, poorly insulated wires, or poor ground contact cause problems such as noise, which are wrongly interpreted to be within the instrument consoles. Problems within the current electrode circuit will be indicated on the Ground Resistance Test Meter or by activation of the Open Loop Protection Circuit.

8.6 Protection from Shock

The IPC-8/250W is a robust field instrument which will easily withstand normal field wear. However, it is a precision instrument which cannot be expected to undergo abnormally rough treatment.

8.7 Protection from Moisture

The IPC-8/250W is well sealed and can withstand moist conditions. However, avoid using it continuously in rain and avoid immersion under water. If excessive moisture builds up inside, the case can be opened (see 8.1) and the instrument dried.

8.8 Storage

Any electronic instrument will be detrimentally affected by storage for long periods in high humidity, particularly at warm temperatures. If dry conditions are not available, at least use a dessicant and change it from time to time.

8.9 Electronic Repairs

In the event a malfunction occurs, trouble shooting of the instrument can be done with the assistance of schematics available on demand from Scintrex. Great care must be taken in operating the transmitter without its case because of high voltages.

The programmer plug-in printed board may be removed for uninterrupted testing of the convertor. A resistor of approximately 1kΩ, 1W has to be connected between terminal K and ground, to start the convertor.

The programmer is best checked in place. It is advisable to disable the convertor to avoid the presence of high voltages, by disconnecting the black wire-centre tap from T1 (1½" diameter toroidal transformer).

Scintrex is prepared, in our plant in Concord, Ontario, to carry out any necessary repairs. Further, we are pleased to assist in trouble shooting by telephone, telex or written communication. Please advise us of the exact symptoms of the problem, and chances are we can suggest the cause of the problem and ship replacement parts from our inventory.

9.0 Warranty and Repair

All Scintrex instrumentation is warranted against defects in material and workmanship for a period of one year from the date of shipment from our plant.

Should any defects become evident under normal use during this warranty period, Scintrex will make the necessary repairs free of charge.

This warranty does not cover damage due to misuse or accident and will be voided if the instrument consoles are opened or tampered with by persons not authorized by Scintrex Limited.

To validate the warranty, the warranty card supplied with the instrument must be returned to Scintrex within 30 days of shipment from our plant.

Instruments shipped for repair from outside Canada should be addressed to Scintrex Limited, care of: Murray and Robinson Customs Brokers, Toronto International Airport, Canada. Since Scintrex instruments are manufactured in Canada there is no customs delay or duty payable in Canada. It is wise to show on customs documents "Canadian Goods Returned to Canada for Repair". Shipments should be made by air. From inside Canada, ship by air directly to Scintrex Limited, 222 Snidercroft Road, Concord, Ontario.

No instrument will be accepted for repair unless it is shipped prepaid. After repair it will be returned collect.

Please mention the instrument serial number in any communication regarding equipment based on purchased from Scintrex.

Scintrex Limited
222 Snidercroft Road
Concord, Ontario
L4K 1B5

Cable: Geoscint Toronto

Telex: 06-964570

Telephone: (416) 669-2280

10.0 Addenda and Errata